

REMARKS

Status of the Claims

Claims 1-15 were examined in the application following Request for Continuing Examination. No additional claims are added. Claim 1 is presently further amended; claims 5 and 10 are cancelled. Claims 1-4, 6-9 and 11-15 remain. Non-substantive informal amendments in other claims remove numbering therein of elements, as a matter of consistent form.

The amendment in claim 1 is to clarify the structure so as to put claim 1 in better condition for allowance. The amendment to claim 1 is not new matter; it is taken from the general disclosure and, as previously amended, from page 3, lines 19 to 21 of the published priority document WO 2005/031250.

Reconsideration of the claims is requested for the reasons set out below.

Summary of the Rejections

For convenience of Examiner and Applicant, the rejections are quoted below.

Examiner has now rejected claims 1-8, 10, 11, 14 and 15 under Section 103(a) over Lawrence et al. US 5,760,593

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["Lawrence"] in view of Drewes et al. US 6,374,680

["Drewes"] contending at page 2 that

Lawrence discloses a sensor (1) for capacitively measuring the distance to a stationary or passing object [the sensor] comprising an electrode (4) for capacitively coupling with the object, a shield (8, 10) that surrounds the electrode (1) [did Examiner mean 4)?] and is electrically isolated from the electrode (1) by an insulating layer 16, and a housing (21) that substantially surrounds the electrode (1) [did Examiner mean (4)?] and the shield (8, 10), wherein the electrode (1) and the shield (8, 10) are formed from an electrically conductive ceramic material the insulating layer (16) and the housing (2) are formed entirely from an electrically non-conductive ceramic material, and in that the electrically conductive and electrically non-conductive materials are selected to have substantially similar thermal expansion coefficients (Col. 3 lines 25-61).

But Examiner also concedes (bottom of page 2) that

Lawrence et al. does not disclose the sensor assembly is formed entirely [of] ceramic materials such that the sensor assembly remains virtually stress free at high operating temperature.

Examiner further urged (page 3) that

Drewes et al. discloses a capacitive sensor (Figures 1-4) and further discloses sensor is formed entirely [of] ceramic materials (Drewes et al.'s column 6 lines 9-59) [such?] that the sensor assembly remains virtually stress free at high operating temperature for the purpose of enhancing [did Examiner mean "reducing"?] the drifting in [the?] capacitive sensor (it is inherent that the materials have the same thermal [did Examiner mean to include "expansion"

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here?] coefficient (Drewes et al.'s column 6 lines 13-16) [to?] retain the sensor assembly stress free.

Examiner further said (page 3, 2d paragraph):

It would have been obvious to one of ordinary skill in the art at the time the invention was made to incorporate [a?] sensor assembly [that?] is formed entirely of materials to remain the [should Examiner omit "the"?] virtually stress free at high temperature as taught by Drewes et al.'s [et al?] into the system of Lawrence et al. because matching thermal expansion coefficients of different materials to reduce drift is routine in the art of sensors operation in high temperature (See also Ko (6,466,271) which applied to reject the claims in previous Office action).

The foregoing rejection language (page 3, 2d paragraph) has errors that cause difficulty for Applicant in an attempt to understand Examiner's precise rejection. For example, this language of page 3, 2d paragraph does not make logical sense to the undersigned: "It would have been obvious to one of ordinary skill in the art at the time the invention was made to incorporate sensor assembly is formed entirely of materials to remain the virtually stress free at high temperature as taught by Drewes et al.'s into the system of Lawrence et al. because matching thermal expansion coefficients of different materials to reduce drift is routine in the art of sensors operation in high temperature (See also Ko (6,466,271) which applied to reject the claims in previous Office action)."

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Therefore, would Examiner please rephrase that rejection to make clear to Applicant what is meant?

So also, Examiner does not cite any authority for the statement "matching thermal expansion coefficients of different materials to reduce drift is routine in the art of sensors operation in high temperature" and Applicant cannot agree because Applicant does not know what Examiner means by this; and believes Examiner has gone beyond the teachings of the art. Would Examiner please rephrase that rejection to make clear on what authority Examiner relies?

Even so, we now turn to claims 5 and 10, as to which Examiner said:

With respect to claims 5, 10, Lawrence et al. discloses a first electrically conductive bridge connected to the electrode (4) and connectable to the conductor of a transmission cable; and a second electrically conductive bridge connected to the housing (2) and connectable to the conductor of a transmission cable (Col. 6 line 26-30).

Applicant disagrees with Examiner's rejection of previously amended claim 1, and herein incorporates by reference and repeats the previous arguments in the response in support of claim 1 before it was presently amended. But in order to still more clearly define over the art, claim 1 has been presently further amended to set forth features described and shown in the application's including specification and drawings which Applicant

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believes do indeed depart from the various cited references.

Summary of the Amendments

Therefore, to assist in understanding the amendments now provided, in the copy of claim which follows, the features are here nevertheless identified by reference characters shown in bold to assist Examiner. Thus, with the help of reference characters the claim now provides:

1. (presently further amended) A sensor (100) for capacitively measuring the distance to a stationary or passing object comprising:

a sensor assembly having an electrode (102) for capacitively coupling with the object, a shield (105) that surrounds the electrode (102) and is electrically isolated from the electrode (102) by an insulating layer (104), and a housing (106) that substantially surrounds the electrode (102) and the shield (105);

a first electrically conductive bridge (107) connected to the electrode (102) and connectable to a first conductor (51) of a transmission cable (50);

a second electrically conductive bridge (109) connected to the shield (105) and connectable to a second conductor (52) of the transmission cable (50);
and

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a third electrically conductive bridge (111)
connected to the housing (106) and connectable to a
third conductor (53) of the transmission cable (50);

wherein the electrode (102) and the shield (105) are formed entirely from an electrically conductive ceramic material and the insulating layer (104) and the housing (106) are formed entirely from an electrically non-conductive ceramic material such that the sensor assembly is formed entirely from ceramic materials, and in that the electrically conductive and electrically non-conductive ceramic materials are selected to have substantially similar thermal expansion coefficients, such that the sensor assembly remains virtually stress free at high operating temperatures.

In essence, the amendment incorporates the features of claims 5 and 10 into claim 1 to define the use of electrically conductive bridges (bridge pieces) connected between the electrode, shield and housing of the sensor assembly and the respective conductor of a transmission cable. Claims 5 and 10 are accordingly deleted.

Summary of the Disclosure

Figs. 1-4 are not presently germane as the structure therein lacks a shield, a feature of the present claims. Refer to Fig. 5. Examiner will find that the bridge pieces 107, 109 and 111 are clearly shown in Fig. 5 of the present application. More particularly Examiner should note these

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illustration features which will aid understanding how the invention has been illustrated:

- a front bridge piece 107 is bonded to a rear face 108 of the electrode 102;
- an intermediate bridge piece 109 is bonded to a rear face 110 of the shield 105, and
- a rear bridge piece 111 is bonded to a rear face 112 of the housing 106.
- The bridge pieces extend away from the front face 103 of the electrode 102 (i.e. the face that in use is directed toward a stationary or passing object to be sensed).

Examiner can see that the front, intermediate and rear bridge pieces 107, 109 and 111 are connected to the three concentric conductors of the triaxial transmission cable 50 as shown in Figure 6.

Summary of Comparison of Claims to the Cited Art

Now then, let us return to the specifically claimed features as set forth in claim 1. As the claim provides:

a first electrically conductive bridge (107) connected to the electrode (102) and connectable to a first conductor (51) of a transmission cable (50);

a second electrically conductive bridge (109) connected to the shield (105) and connectable to a second conductor (52) of the transmission cable (50); and

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a third electrically conductive bridge (111) connected to the housing (106) and connectable to a third conductor (53) of the transmission cable (50);

Application of Claim 1 Added Features to Disclosure

How does Applicant disclose these claimed features? Examiner will further be able to see that the triaxial transmission cable has a central conductor 51 connected to the electrode 102 by means of the front bridge piece 107. The triaxial transmission cable also has an intermediate conductor 52 and an outer conductor 53 connected to the shield 105 and housing 106, respectively, by means of the intermediate bridge piece 109, the rear bridge piece 111 and an electrically conductive adaptor 60. In other words, the intermediate bridge piece 109 is bonded to a rear face 110 of the shield 105 and is then connected to the intermediate conductor 52 of the triaxial transmission cable by the adaptor 60. The triaxial transmission cable 50 can also be connected to the bridge pieces 107, 109 and 111 in a perpendicular arrangement as shown in Figure 7, depending on the particular mounting requirements.

Examiner can understand from these disclosed features that bridge pieces 107, 109 and 111 are bonded to the electrode 102, shield 105 and housing 106 and are therefore an integral part of the sensor but not the sensor assembly, which is now, as set forth in claim 1, defined as being formed entirely of ceramic material. In contrast to this,

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the adaptor 60 is not part of the sensor and is simply used to connect the intermediate and rear bridge pieces 109 and 111 to the respective conductors 52 and 53 of the triaxial transmission cable, as well as facilitating the proper alignment between the bridge piece 107 and the central conductor 51.

Summary of the Advantages Compared to the Art

In conventional capacitive sensors (such as those disclosed in Lawrence et al., for example) the conductors of the triaxial transmission cable are bonded directly to the rear surfaces of the electrode, shield and housing. This means that the bond between the conductors of the triaxial transmission cable and the component parts of the sensor is exposed to high temperatures given that the sensor itself may experience operating temperatures in excess of 1200°C. It is therefore typical of conventional capacitive sensors for the bond to fail after a short period of time. The sensor must then be discarded. By providing instead the presently inventive bridge pieces (which unlike the narrow conductors of the triaxial transmission cable can be securely bonded to the rear faces of the electrode, shield and housing), the advantage occurs that the bond with the conductors is located in a low temperature region at the rear of the sensor.

Moreover, still other advantages result: the use of the inventive bridge pieces effectively provides exposed electrical contacts at the rear of the sensor that allows

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each sensor to be tested before it is bonded to the triaxial transmission cable. This is not possible with conventional capacitive sensors where the conductors of the triaxial transmission cable have to be directly connected to the electrode, housing and shield during the assembly process.

Possible Misunderstanding of Lawrence

On page 3 of the Office action, Examiner has dismissed claims 5 and 10 on the stated basis that such electrically conductive bridges are disclosed in Lawrence et al. 5,760,593 ("Lawrence"). This would appear to be a clear misrepresentation of the teaching of Lawrence for the reasons given below.

We can find only three passages in US 5760593 (Lawrence et al.) that deal with the connection of the sensor to a triaxial transmission cable. Column 1, lines 40 to 45 describes the known prior art and explains how *"the electrode is connected to the centre conductor of a triaxial cable, and the shield to the intermediate screen of the cable while the retainer or the housing is connected to the outer screen of the cable . . ."*. We believe this clearly states that the various conductors of the triaxial transmission cable are connected directly to the respective component parts of the sensor.

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The Examiner has pointed to the passage at column 5, lines 26 to 30 to support his objection: "The electrode 4 is connected to the centre conductor of a triaxial cable (not shown) by conventional means, while the screen formed by the top and bottom guards 8 and 10 are connected to the intermediate screen of the triaxial cable." Applicant completely fails to understand how the words "by conventional means" can be taken to disclose the use of bridge pieces. It is clear in the context of Lawrence, taken as a whole, that such "conventional means" refers to the typical bonding of the central conductor of the triaxial transmission cable directly to the electrode.

The assembly of the Lawrence sensor is fully described at column 5, lines 39 to 67, and this represents the clearest Lawrence explanation of how the bonding is carried out. For example, the "top guard 8 and bottom guard 10 are then welded together and a hole is drilled through the cylindrical part 13 of the top guard 10 generally at a level of the end of the electrode to enable the triaxial cable to be inserted. The cable (not shown) is cut back and inserted through the hole and the central wire is brazed to the end face of the electrode and the intermediate screen is brazed to the top guard 10." [emphasis added]. In addition, the "outer screen of the triaxial cable is welded to the ending casing and a thin piece..." [emphasis added]. In other words, the central conductor of the triaxial transmission cable is bonded directly to the rear face of the electrode, the

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intermediate conductor is bonded directly to the shield, and the outer conductor is bonded directly to the housing. There is nothing here in Lawrence to suggest the use of bridge pieces. Applicant could only hope that Examiner will again read Lawrence and come to proper understanding of its disclosure.

Examiner has relied on Bailleul et al. 5,973,502 ("Bailleul") to reject the claims directed to the use of the adaptor 60. Applicant respectfully questions whether Examiner really understands this document. Applicant could only hope that Examiner will again read Bailleul and come to proper understanding of its disclosure. To assist Examiner, the following explanation is provided:

Bailleul is also directed to a capacitive sensor, but the Bailleul construction lacks a shield between the electrode and the housing, being accordingly outside the scope of the present claims. The Bailleul metal electrode 4 is cone-shaped and includes a stem 5 that extends away from the front face 4a. It is surrounded by an insulating ring 9. The insulating ring 9 is secured to the stem 5 by a weld 11b. A metal housing 2 has a front part for receiving the electrode 4 and insulating ring 9. Metal housing 2 has a rear part for receiving a coaxial cable 20. The insulating ring 9 is locked in place within the housing 2 by a locking ring 3. It is important for Examiner to note that such locking ring 3 of Bailleul does not correspond to the shield found in the sensor of the present

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invention. Locking ring 3 is secured to the insulating ring 9 and the housing 2 by welds 11a and 11d.

The rear end of the Bailleul stem 5 includes a recess 17. The Bailleul central conductor 21 of the coaxial cable 20 is received in this recess and is secured in place by weld 11b. In other words, the Bailleul central conductor 21 of the coaxial cable is connected directly to the electrode 4 (or more particularly its stem part).

The Bailleul outer conductor 10 of the coaxial cable 20 is received in the rear part of the housing 2 and is secured in place by weld 11a. In other words, the Bailleul outer conductor 10 is connected directly to the housing 2. On page 4 of the Office action Examiner has argued that the weld 11b represents an adapter for connecting the "second electrically conductive bridge (21a) to the conductor of a transmission cable (21)". This does not make sense to Applicant. Examiner seems to suggest that the bare part 21a of the coaxial cable that is received in the recess 17 is the second electrically conductive bridge (i.e. equivalent to the front bridge piece 107 of the present invention). But that is incorrect because the bare part 21a is just a part of the central conductor 21. It is not a front bridge piece nor suggestive thereof. The Bailleul weld 11b secures the bare part 21a to the electrode 4 and "ensures a very good electrical contact . . ." (column 3, lines 37 and 38). The Bailleul stem 5 is not the same as, and is not suggestive of the front bridge piece 107 of the

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present invention. The Bailleul stem 5 is instead an integral part of the electrode 4 and is not formed separately and connected to it like the front bridge piece 107.

In any event, Bailleul does not disclose the use of a shield and that the use of intermediate and rear bridge pieces to connect the intermediate and outer conductors of the triaxial transmission cable to the shield and housing, respectively, is not obvious to the skilled artisan from the combination of Bailleul and Lawrence.

Applicant points out that Drewes et al. 6,374,680 ("Drewes") Ko et al. 6,466,271 ("Ko") relates to pressure sensors, and considers that they are not relevant to the amended claim 1 set out above. In other words, it cannot be seen that anything in Drewes or Ko teaches or suggests the skilled person to use bridge pieces between the component parts of the sensor and the respective conductor of the triaxial transmission cable.

Summary of Requested Action

In view of these precise points, Examiner is asked to reconsider claim 1, as amended, for it sets forth a combination which Lawrence et al. 5,760,593 and Drewes et al. 6,374,680 Lawrence et al. have neither taught nor suggested. Claim 1 is submitted to be patentably unobvious thereover. Claim 1 should accordingly be held allowable.

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Claims 2-4, 6-9, and 11-15 are believed also be allowable for same reasons as being dependent from claim 1 either directly or indirectly.

Accordingly, very careful reconsideration of claims is warranted and is requested.

In view of the foregoing, entry of this amendment, withdrawal of the remaining rejections, and a formal notice of allowance are requested.

If Examiner intends to take any action other than allowance, or if any issue could be readily resolved or other action could be taken to advance this application, such as Examiner's amendment, it is requested that Examiner please telephone the undersigned.


It is believed that the foregoing resolves all remaining issues, and the application is in good order for allowance, and a Notice of Allowance is solicited. The undersigned looks forward to working with Examiner to resolve any remaining issues in the application. If Examiner has any questions or believes there is any remaining issue, which could be readily resolved or other action could be taken to advance this application, such as by Examiner's amendment or interview by telephone or in person, it is requested that Examiner please telephone or e-mail the undersigned representative to arrange telephone

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interview, and the undersigned will gladly cooperate to advance the prosecution.

Respectfully submitted,

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